The Proximate Composition and Element Spectrum of the Flesh of the Three Cichlid Species in the Victoria Reservoir

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Abstract

Laboratory analysis conducted on the nutritional quality of the flesh of the three cichlid species in the Victoria reservoir yielded the following quantitative values. The protein content ranged between 79.91±2.13 to 84.38±1.18 percent with a high proportion of essential amino acids of which lysine and leucine were predominant. The lipid content varied between 10.08±0.82 and 10.92±2.32 on a percentage dry weight basis while the element spectrum revealed that the flesh also had a high mineral content. Although no major differences were evident, the analytical results showed that the flesh of *O. niloticus* had a higher protein and lipid content with more sodium, potassium, carbon and nitrogen.

Introduction

One of the biggest problems that confronts Sri Lanka today is to find ways and means of improving food production. Finding adequate protein supplies to meet the needs of the increasing population is thus a high priority.

Fish is the chief source of animal protein in the cereal based diet of the Sri Lankans. In the present context it is important to increase the protein availability by utilizing the fish found in reservoirs. Apart from the work of De Silva & Rangoda (1979) who assessed the chemical composition of fresh and salt dried *Oreochromis mossambicus* from Beira lake and Jayawardena & Jayaweera (1979) who have studied the storage and composition of tilapia flesh, and the more recent work of Wimalasena & Jayasooriya (1996) on the nutrient composition of some important fresh-water fish species in Sri Lanka, there is no recorded information regarding the relative nutritional values of different cichlid species which are the mainstay of the reservoir fisheries in Sri Lanka.

There is wide scope for developing the fishery at the Victoria reservoir into a productive biological resource. Therefore, a comparative study has been made to evaluate the proximate composition and element spectrum of the three cichlid species in this reservoir to see whether there were any major differences in the nutritional quality of their flesh.

Materials and Methods

Fresh fish samples of the three cichlid species (*O. mossambicus*, *O. niloticus* and *Tilapia rendalli*) from the fish landing sites of the Victoria reservoir were transported to the laboratory for comparative analysis of the nutritional quality of the edible flesh. Three individual samples for each species from a mixture of flesh (devoid of skin and bone) obtained from 5-10 fish within the size class 20-25 cms and maturity stage I-III (irrespective of sex) were taken for comparative analyses. Each sample was analysed in duplicate. Ten grams of the above mixture from each species was

weighed to the nearest mg and dried at 80°C to a constant weight. The moisture content was estimated from the difference in the values obtained in weight.

The oven-dried muscle was then finely ground and aliquots of the ground material was used for analysis. The carbon, hydrogen and nitrogen contents of the oven dried flesh samples of the three cichlid species were estimated using a CHN analyser. The protein content was calculated by multiplying the nitrogen values obtained by the factor 6.25. Using an Amino Acid Analyser (Joel model 6 AH) the amino acid composition of the samples were estimated. Total lipids were determined gravimetrically according to the procedure of Folch et al. (1957) using a soxhlet apparatus. The ash content was estimated by burning 250 mg of finely ground dried muscles of the three cichlid species overnight in a muffle furnace at 550°C.

The mineral nutrients namely phosphorous, sulphur, potassium, calcium, magnesium and sodium were estimated by a wet digestion method using concentrated sulphuric and nitric acid, or concentrated nitric and perchloric acid in a fume cupboard. Sulphur was determined by the turbidimetric method of Tabatabai (1978), while phosphorous was determined by the Vanado-molybdo-phosphoric acid colorimetric method (APHA 1989). A Shimadzu atomic absorption/ flame emission spectrophotometer (model AA-670) was used to determine concentrations of potassium, calcium, magnesium and sodium. All determinations were carried out in triplicate.

Results

Between 49 to 51 percent of the total body weight of these three cichlid species constitute the edible portion.

Proximate composition

Table 1 gives the proximate composition of the muscles of the individual cichlid species. Protein constitutes the highest source of metabolizable energy and is the most important nutritional component of the flesh.

Of the three cichlid species *O. niloticus* had the highest proportion of protein and lipid and the lowest moisture content (77.1% compared to 78.2 and 79.0 percent in *O. mossambicus* and *T. rendalli* respectively). Lysine and leucine were the most dominant of the essential amino acids for man. The values obtained for the individual species are given in Table 2.

Element spectrum

Table 3 gives the comparative values obtained for carbon, hydrogen and nitrogen for the three species, while Table 4 gives the mineral nutrient composition in the flesh. The results indicate that these fish are a good source of mineral nutrients. When the three cichlid species were compared *O. niloticus* had a higher proportion of sodium, sulphur, potassium, carbon and nitrogen in the flesh than the others.

Table 1. Proximate composition (on a percentage dry weight basis) (mean ± SE) of the muscles of the three cichlid species at the Victoria reservoir.

Species	Protein	Lipid	Ash
O. mossambicus	80.37±2.38	10.19±1.40	5.41±0.53
O. niloticus	84.38±1.19	10.92±2.3	5.87±0.95
T. rendalli	79.91±2.13	10.08±0.82	4.89±0.87

Table 2. Proportion of Essential Amino Acids (for humans) expressed as a percentage of protein (on a dry weight basis) (mean ± SE) in the muscles of the three cichlid species.

Amino Acid	*O. mossambicus*	*O. niloticus*	*T. rendalli*
Lysine	7.85±0.08	8.13±0.15	7.71±0.31
Leucine	7.30±0.09	7.98±0.07	7.05±0.62
Arginine	5.21±0.29	5.83±0.34	5.65±0.83
Valine	4.34±0.05	4.31±0.10	4.31±0.37
Isoleucine	4.14±0.06	3.98±0.06	4.03±0.02
Threonine	3.43±0.02	3.40±0.04	3.67±0.05
Phenyl alanine	3.86±0.16	3.98±0.18	3.85±0.03
Methionine	2.36±0.03	2.26±0.03	2.06±0.04
Histidine	1.90±0.02	2.20±0.01	1.84±0.09
Total	40.39	42.07	40.17

Table 3. The carbon, hydrogen and nitrogen content in the muscles of the three cichlid species (on a percentage dry weight basis) (mean ± SE).

	O. mossambicus	*O. niloticus*	*T. rendalli*
Carbon	46.31±1.01	49.94±0.71	45.85±1.21
Hydrogen	7.23±0.33	7.15±0.94	7.01±0.75
Nitrogen	12.86±0.38	13.50±0.19	12.79±0.34
Others	33.60±1.38	29.41±1.98	34.35±2.34

Table 4. The mineral content of the flesh of the three cichlid species (mg/100g dry weight basis). Ranges are given in parentheses.

Element	*O. mossambicus*	*O. niloticus*	*T. rendalli*
Potassium	1622.72 (1553-1756)	1929.41 (1705-2215)	1715.94 (1575-1786)
Phosphorous	825.08 (818-830)	797.10 (780-810)	780.24 (770-789)
Sulfur	558.02 (500-602)	596.67 (540-630)	593.33 (560-620)
Sodium	300.97 (287-327)	312.73 (292-324)	223.98 (194-241)
Magnesium	132.89 (126-137)	130.40 (125-137)	148.26 (140-157)
Calcium	91.92 (79-112)	103.01 (89-118)	115.47 (82-134)

Discussion

As far as nutrition is concerned, the principal value of these fish lies in the fact that they are a good source of protein and could help in combating malnutrition, especially during early childhood. The fat content is characterised by the high level of polyunsaturated fatty acids which is an advantage for those who require diets low in cholesterol (Tayoma & Kaneda 1962). The proximate composition of these cichlids is similar to those reported for marine fish in Sri Lanka by Peiris & Grero (1972, 1973). Further, the moisture, protein, lipid and ash content of marine fish has been reported to vary between 66-84%, 15-20%, 0.1-20% and 0.8-2% respectively (Borgstrom 1961). The values obtained during this investigation for the

different constituents calculated back to a percentage fresh weight fall within the same range (moisture 77-79%, protein 16-19%, lipid 2.1-2.5%, and ash 1.0-1.4%). Hence, these cichlids could be recommended as a less expensive nutritional substitute.

The findings in respect of protein and amino acids are not very different from those reported by Mai et al. (1980) either. Their results reveal that there were no major differences in the protein and amino acid contents of the six different species of freshwater fish examined by them, nor were the values obtained very different from those of marine fish.

The proximate composition is known to be influenced by a number of factors associated with both the internal physiological condition of the fish as well as the external environment (Love 1970). De Silva et al. (1983) have shown that the proximate composition of *O. mossambicus* falls within a wide range during different stages of maturation and that it also changes significantly during peak maturity (stages IV and V) and spawning. Investigations carried out on different species of fish indicate that apart from a decrease in moisture content with growth, the proximate composition of fish changes only slightly with size (De Silva & Rangoda 1979). Wimalasena & Jayasuriya (1996) point to certain differences in the values obtained during the past in proximate analyses of freshwater fish species in Sri Lanka. These discrepancies may be attributed to differences in analytical methods used, inadequate sample sizes, the fact that the maturity stage of the selected fish samples have been overlooked and differences in the environmental conditions and quality of food available in the locations from where the fish species have been collected.

Although no major differences were evident, the analytical results showed that the flesh of *O. niloticus* was nutritionally the best having a higher protein and lipid content with more sodium, sulphur, potassium, carbon and nitrogen.

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